The Dynamical-Statistical Forecast System TCWB2T2 Developed at CWB
中央氣象局動力統計短期氣候預報系統TCWB2T2

Mong-Ming Lu*, Jhy-Wen Hwu, Yea-Ching Tung, and CWB CFS Team
Research and Development Center Central Weather Bureau Taipei, Taiwan
***Email: lu@rdc.cwb.gov.tw**

Abstract

The second version monthly and seasonal climate two-tier forecast system developed at the Central Weather Bureau (CWB) of Taiwan, TCWB2T-2, started to make real-time operational testing since January 2016. A focus of the development endeavor is to provide useful long-range outlook information for risk management associated with high-impact weather. The monthly and seasonal rainfall prediction downscaled to 16 Taiwan stations is generated from the difference of the real-time forecast probability distribution formed by 620 prediction values and the background forecast probability distribution formed by historical prediction of the training period from 1982 to the latest global forecast operational runs. The prediction skill of the downscaling method provided to the users is based on the evaluation results of the retrospective forecast of 1982-2011. In this paper the monthly and seasonal spring rainfall prediction in northern Taiwan is presented as an example to introduce the forecast system, ensemble strategy, statistical downscaling procedure, forecast product, and related forecast tools.

Main Components in TCWB2T-2

TCWB2T-2 Model Components

Atmospheric Model
CWB GAM T119L40
ECHAM5.2 T42L19
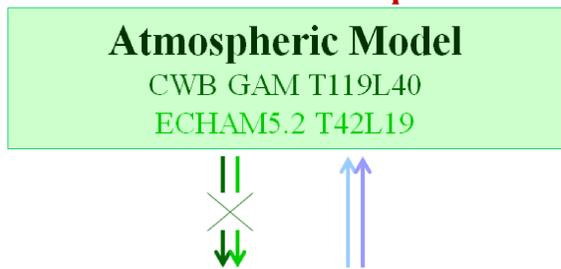
CWB Optimal Global SST forecast module (OPGSSTv2)
- Statistical & Dynamical SST Forecast Models –
Dynamical Models: Intermediate A-O coupled (Kug,Kang,Zebiak 2001): **ICM2a, ICM2b**
Statistical Models & Predictors : [SVD] **Nino3.4**, **BoM/OHC**;
[STPM (Hsu et al. 2012)] BoM/**IO subsurface sea water temperature →**
Predictand: *tropical Pacific SST*
Damped Persistence: **4mo** NOAA/OISSTv2
Prediction Integration Method: MLR MMSE scheme

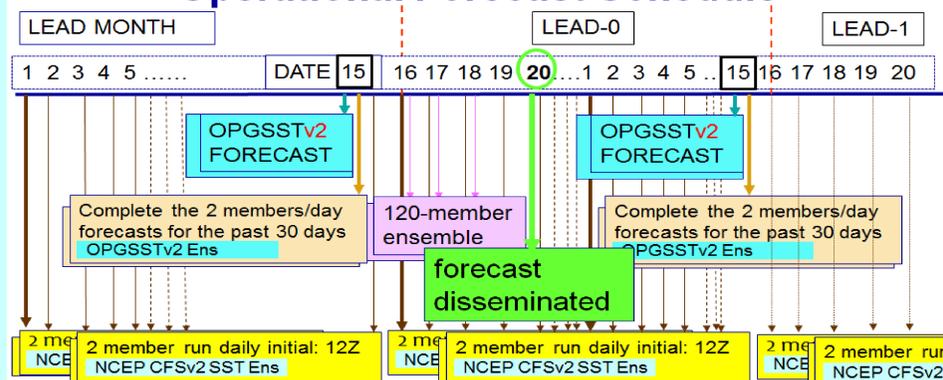**NCEP CFSv2 SST**

Forecast Procedure

CWB 2-tier CFSv2
(real-time operational testing – 2016)
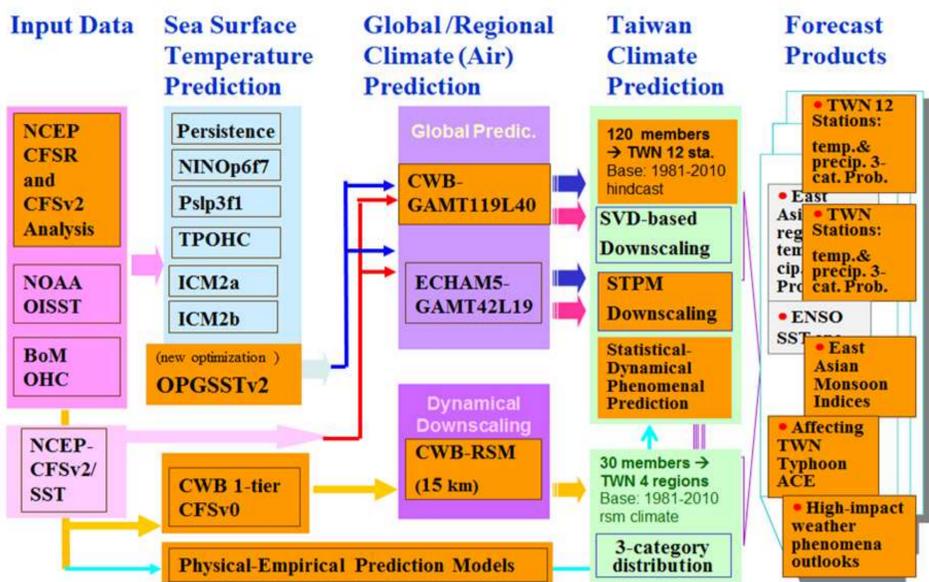
Time-lag Ensemble Strategy

TCWB2T-2
### Operational Forecast Schedule

- IC: GAM- everyday12Z from NCEP/CDAS; OPGSST– 15th of each month from NOAA & BoM
- 2 members run in all IC+2 days (TCWBGA/OPGSST, TCWBGA/CFSSST, ECHAM/OPGSST, ECHAM/CFSSST) with 7 months forecasting.
- Each member need about 40 minutes for model running and another 30 minutes for post process.

TCWB2T2 Forecast Product Example

Forecast dissemination date: 20 April 2016

Global Sea Surface Temperature (SST)
- SST probabilistic forecast in three categories for the season of May-July, 2016.
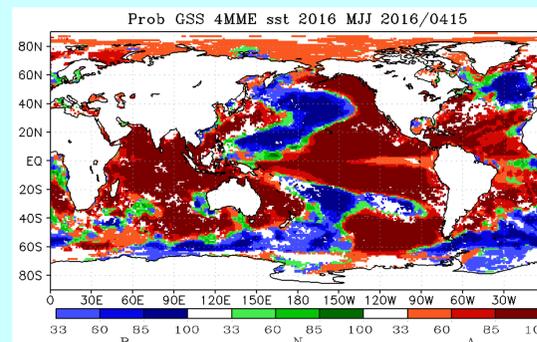

The SST probabilistic forecast masked by the positive values of the Gilbert Skill Score (GSS). GSS > 0 means the forecast is better than random guess. Red color marks above normal, green normal and blue below normal category. Darker color represents higher probability. It shows warm SSTs over the Indian Ocean, eastern Pacific and lower-latitude Atlantic. The SST to the east of Taiwan is above normal.

ENSO
- Nino 3.4* SST anomaly forecast for the period from May to December, 2016.
*Nino 3.4 index is the area averaged SST from 5S-5N and 170-120W.
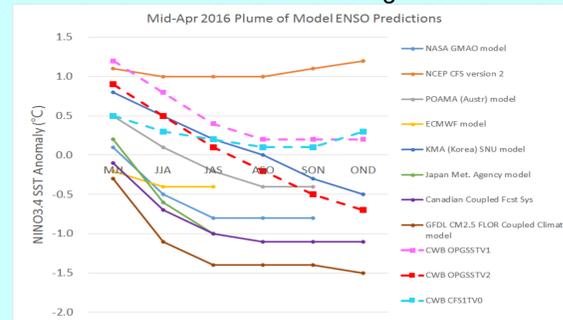
The figure shows that the Nino3.4 Index forecasted by CWB2T2 (red dashed line) shows clear decline of the Nino 3.4 SST since MJJ. The anomaly reaches below -0.5C, the La Niña level if it continues to persist.

#### East Asia and Western North Pacific Summer Monsoon (EAWPSM)
- Precipitation rate probabilistic forecast in three categories for the season of May-July, 2016.
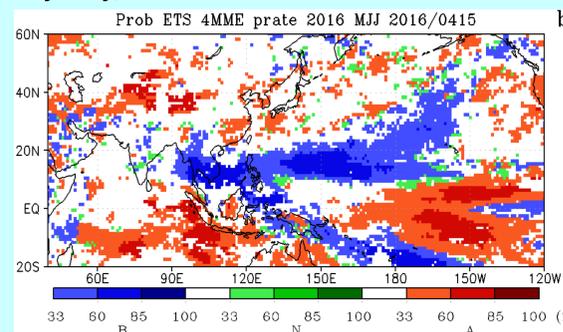
The precipitation rate probabilistic forecast masked by the positive GSS. Red color marks above normal, green normal and blue below normal category. The northern hemisphere subtropics from the South China Sea to the western North Pacific along the latitudes of from 10N to 20N are marked by less than normal rain. The colors around Taiwan show the condition of weak above normal.

Taiwan Mei-Yu Season
- Rain and tempearture probabilistic forecast in three categories for May, June, July, 2016.
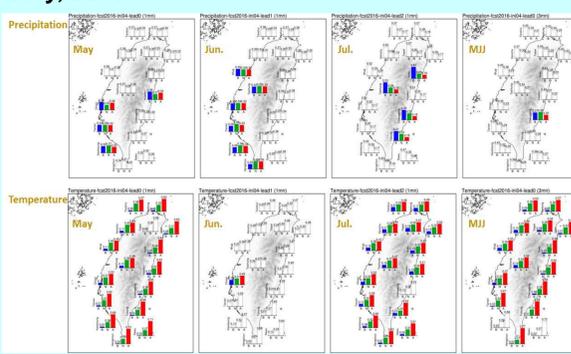
The precipitation and temperature forecast generated by TCWB2T2 is statistically downscaled to 16 Taiwan weather stations. The downscaled forecast skill was carefully evaluated based on 30 years of the retrospective forecast data. The forecast that did not pass the 95% confidence test is presented in the open bars. The forecast suggests that the Mei-Yu season is going to be warm.

- Rain and temperature anomaly forecast for three ten days from May 6th to June 4th, 2016.
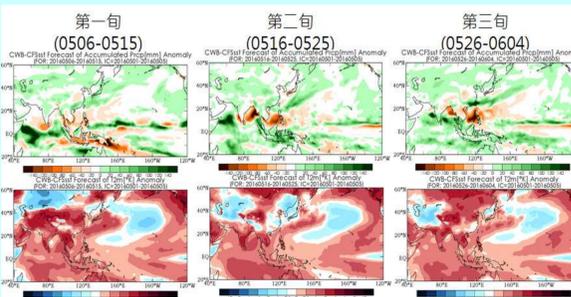
TCWB2T2 operational schedule allows the monthly and sub-monthly forecasts to be updated every 5 days. The forecast completed on May 5th suggests that the first peak of Mei-Yu rainfall may occur in late May and early June.

On-going Work

Physical-Empirical Forecast Models

For high-impact weather systems, it is necessary to develop physical-empirical (P-E) forecast models as auxiliary tools for forecast, model diagnostics and real-time climate monitoring. Several P-E forecast models for predicting: Spring and Mei-Yu rain, summer season Western Pacific Subtropical High (WPSH), affecting Taiwan tropical cyclone (TC) accumulated cyclone energy (ACE) and Taiwan winter temperature have been developed and under real-time forecast evaluation.